ECONOMIC ANALYSIS & POLICY, VOL. 40 NO. 2, SEPTEMBER 2010

Labor Productivity Growth, Education, Health and Technological Progress: A Cross-Country Analysis

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Abstract: This study aims to calculate the growth rates of labor productivity of 30 countries categorized into four groups, including G7 countries, western developed countries, eastern developed countries and eastern developing countries, during 1981 – 2005 and examine the influences of education, health and technological progress on the growth rate of labor productivity. The findings reveal that the growth rates of labor productivity of every country, except the Philippines, were greater than four percent per annum during 1981 – 2005. Eastern developed countries had the highest average annual growth rate of labor productivity, following by western developed countries, G7 countries and eastern developing countries. Additionally, only education and technological progress are the significant determinants of the growth rate of labor productivity.

I. INTRODUCTION

At this moment, several countries in the world have already completed or nearly completed a demographic transition which is a transition from a rural agrarian society with high fertility and mortality rates to an urban industrial society with low fertility and mortality rates (Lee and Mason, 2006). During such a period of time, working-age population (15 – 64 years old) is likely to grow slower than old-age dependent population (65 years old and over), leading to the diminishing proportion of working-age population and the increasing proportion of old-age population.

For instance, the proportions of working-age population of Japan and France reached their peaks in 1990 at 69.7 and 65.7 percent of total population, respectively, and then have been declining afterward. In 2010, working-age population of Japan and France will be only 64.2 and 64.6 percent of total population, respectively. In addition, the proportions of working-age population of China, Hong Kong, Singapore, Thailand and the USA will reach their peaks in 2010 at 71.9, 75.6, 74.2, 70.8 and 66.8 percent of total population, respectively, and will decrease to 71.5, 74.4, 73.6, 70.5 and 65.9 percent, respectively, in 2015 (United Nations, 2009).

Other things being equal, the country will certainly be worse off since the diminishing proportion of working-age population implies the smaller labor force relative to dependent

population. This will eventually cause a detrimental impact on the economic growth and also the standard of living of people in the country. As a result, it is now very essential for every country to find the way to increase labor productivity to offset the diminishing proportion of working-age population so that the smaller labor force can still lead to the economic growth and the better standard of living of people in the country. This statement may be supported by many studies which suggested that the higher labor productivity would lead to the better standard of living (Fisher and Hostland, 2002; Shaw, 2002 and Deiwert et al., 2009).

To find the way to increase labor productivity, there are probably two issues needed to examine beforehand. Firstly, it is necessary to examine the level of labor productivity and also the growth rate of labor productivity to identify the country's situation regarding labor productivity. Many studies (Saari, 2006; Khazabi, 2008 and Deiwert et al., 2009) proposed the methods to measure the growth rate of labor productivity. Secondly, it is necessary to examine the factors determining labor productivity growth to identify the appropriate factors which really contribute to labor productivity growth. According to the review of literatures, there are three factors which are regarded as the major determinants of labor productivity growth.

The first factor is education as normally measured by mean years of schooling which was positively related to labor productivity growth (Yunhua et al., 2000; Duryea and Pages, 2002 and Razzak and Timmins, 2007). The second factor is health as mostly measured by life expectancy at birth which was also positively related to labor productivity growth (Leroex et al., 2003; Hazan, 2006; Knapp, 2007 and Chadha, 2008). The last factor which determines labor productivity growth is technological progress as usually measured by the growth rate of total factor productivity. Several previous studies found that it was also positively related to labor productivity growth (Singh, 2004 and Jajri and Ismail, 2009).

Consequently, this study aims to look at two issues. Firstly, it examines labor productivity growth in 30 countries categorized into four groups, including G7 countries, western developed countries, eastern developed countries and eastern developing countries, during 1981 – 2005 by utilizing the Growth Accounting Equation to calculate the growth rates of labor productivity. Secondly, it examines the influences of education as measured by mean years of schooling, health as measured by life expectancy at birth and technological progress as measured by the growth rate of total factor productivity on the growth rate of labor productivity.

II. RESEARCH METHODOLOGY

1. Data and Sources

This study relies on the secondary time-series data in annual format of 30 countries obtained from various sources during 1981 – 2005. These 30 countries are divided into four groups according to development level[1] and region. The first group includes G7 countries which are Canada, France, Germany, Italy, Japan, the United Kingdom and the United States of America. The second group includes 15 western developed countries which are Australia, Austria, Belgium, Denmark, Finland, Greece, Iceland, Ireland, the Netherlands, New Zealand, Norway,

[1] Developed countries are high-income countries whose 2008 gross national income per capita is 11,906 US dollar or more whereas developing countries are middle-income countries whose 2008 gross national income per capita ranges between 976 and 11,905 US dollar (World Bank, 2009).

Portugal, Spain, Sweden and Switzerland. The third group includes three eastern developed countries which are Hong Kong, South Korea and Singapore. The final group includes five eastern developing countries which are China, Indonesia, Malaysia, the Philippines and Thailand.

Data analyzed in this study include (1) gross domestic product, (2) gross fixed capital formation, (3) labor force, (4) mean years of schooling, (5) life expectancy at birth and (6) the growth rate of total factor productivity. In addition, data of gross domestic product, gross fixed capital formation and labor force were obtained from World Bank, data of mean years of schooling were obtained from UNESCO, data of life expectancy at birth were obtained from the United Nations and data of the growth rate of total factor productivity were based on author's calculation.

2. Analytical Method

The analytical method for this study can be divided into two steps. Firstly, the average annual growth rate of labor productivity of each country is calculated by utilizing the Growth Accounting Equation which represents the relationship between the growth rate of output and the growth rate of inputs and productivity (Bernanke et al., 2008). It can be expressed as the following.

$$\frac{\Delta Q}{Q} = \frac{\Delta A}{A} + \alpha\frac{\Delta K}{K} + \beta\frac{\Delta N}{N} \quad (1)$$

where $\frac{\Delta Q}{Q}$ = the growth rate of output as measured by gross domestic product

$\frac{\Delta K}{K}$ = the growth rate of capital input as measured by gross fixed capital formation

$\frac{\Delta N}{N}$ = the growth rate of labor input as measured by labor force

$\frac{\Delta A}{A}$ = the growth rate of total factor productivity

α = the elasticity of output with respect to capital input

β = the elasticity of output with respect to labor input

Supposing that each country is operating at an optimal level and production function of each country performs constant return to scale (CRS)[2]. Therefore, the elasticity of output with respect to capital input (α) plus the elasticity of output with respect to labor input (β) equals to one. That is, $\alpha+\beta = 1$ and also $\beta = 1 - \alpha$. Here we have,

$$\frac{\Delta Q}{Q} = \frac{\Delta A}{A} + \alpha\frac{\Delta K}{K} + (1-\alpha)\frac{\Delta N}{N}$$

$$\frac{\Delta Q}{Q} = \frac{\Delta A}{A} + \alpha\frac{\Delta K}{K} + \frac{\Delta N}{N} - \alpha\frac{\Delta N}{N}$$

[2] The assumption of constant return to scale is originally based on Solow (1956) which has been later relaxed in some other studies (Fingleton and McCombie, 1998 and List and Zhou, 2007).

$$\frac{\Delta Q}{Q} - \frac{\Delta N}{N} = \frac{\Delta A}{A} + \alpha\left(\frac{\Delta K}{K} - \frac{\Delta N}{N}\right) \quad (2)$$

According to equation (2) above, the growth rate of labor productivity is $\frac{\Delta A}{A} + \alpha\left(\frac{\Delta K}{K} - \frac{\Delta N}{N}\right)$.

Moreover, based on the historical data and previous studies, the elasticity of output with respect to capital input and the elasticity of output with respect to labor input are supposed to be (1/3) and (2/3), respectively. These figures were found across the developed and the developing countries such as the USA (Bernanke et al., 2008) and China (Feng and Mason, 2005).

The second step is to examine the influences of education, health and technological progress on the growth rate of labor productivity by employing the multiple regression analysis. The equation to be estimated can be expressed as the following.

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \delta_1 r_1 + \delta_2 r_2 + \delta_3 r_3 + \mu \quad (3)$$

where
- y = average annual growth rate of labor productivity
- x_1 = education as measured by mean years of schooling
- x_2 = health as measured by life expectancy at birth
- x_3 = technological progress as measured by the average annual growth rate of total factor productivity[3]
- r_1 = 1 if G7 countries and 0 otherwise
- r_2 = 1 if western developed countries and 0 otherwise
- r_3 = 1 if eastern developed countries and 0 otherwise

III. RESULTS AND DISCUSSION

Results of the study are divided into two sections. The first section presents the growth rates of labor productivity of 30 countries during 1981 – 2005 whereas the second section shows the results of the regression analysis, identifying the influences of education, health and technological progress on the growth rate of labor productivity.

1. Growth Rate of Labor Productivity

The average annual growth rates of labor productivity of 30 countries categorized into four groups during several periods of time are presented in *Table 1*. The findings reveal that the average annual growth rates of labor productivity of every country, except the Philippines whose average annual growth rate of labor productivity was only 2.02 percent per annum, were greater than four percent per annum during 1981 – 2005. Eastern developed countries had the

[3] The growth rate of total factor productivity can also be calculated by employing the Growth Accounting Equation. It equals $\frac{\Delta A}{A}$ in equation (1). Consequently, the growth rate of total factor productivity equals $\frac{\Delta A}{A} = \frac{\Delta Q}{Q} - \alpha\frac{\Delta K}{K} - \beta\frac{\Delta N}{N}$

highest average annual growth rate of labor productivity during 1981 – 2005 of 7.64 percent per annum, following by western developed countries, G7 countries and eastern developing countries whose average annual growth rates of labor productivity equaled 5.62, 5.19 and 5.13 percent per annum, respectively.

The average annual growth rates of labor productivity of every eastern developed country were very high during 1981 – 2005. South Korea had the highest average annual growth rate of labor productivity during the study period of 9.46 percent per annum, following by Singapore and Hong Kong whose average annual growth rates of labor productivity were 7.28 and 6.17 percent per annum, respectively. During 1981 – 1985, the average annual growth rate of labor productivity of this group was very high at 4.88 percent per annum. South Korea could do the best during this period having the highest average growth rate of labor productivity of 6.76 percent per annum, following by Singapore and Hong Kong with the average annual growth rates of 5.78 and 2.10 percent per annum, respectively.

During 1986 – 1995, labor forces of the eastern developed countries were said to be far more productive with the average annual growth rates of labor productivity higher than 12 percent per annum. South Korea had the highest average annual growth rate of labor productivity during 1986 – 1990 of 19.36 percent per annum while Singapore had the highest average annual growth rate of labor productivity during 1991 – 1995 of 15.46 percent per annum. However, the economic crisis which erupted in Thailand in 1997 and spread over the region caused the economic downturn in almost every country in east and south-east Asia, leading to a sharp drop in the average annual growth rate of labor productively of the eastern developed countries to 0.55 percent per annum during 1996 – 2000. During 2001 – 2005, the average annual growth rate of labor productivity of this group rose to 3.62 percent per annum. South Korea and Singapore had the high average annual growth rates of labor productivity of 7.80 and 3.53 percent per annum, respectively, whereas Hong Kong had the negative average annual growth rate of -0.47 percent per annum.

Now let's look at western developed countries. Based on *Table 1*, labor productivity growth of the western developed countries were also very high during 1981 – 2005. Ireland had the highest average annual growth rate of labor productivity of 8.21 percent per annum, following by Portugal with the average annual growth rate of 7.20 percent per annum. Additionally, eight countries had the average annual growth rates of labor productivity higher than five percent per annum whereas only five countries including Australia, Belgium, Netherlands, Sweden and Switzerland had the average annual growth rates greater than four percent per annum but less than five percent per annum.

During 1981 – 1985, almost every western developed country experienced the reduction in labor productivity with the negative average annual growth rates of labor productivity probably due to the second oil crisis which happened in the early of 1980s, stemming from the war between Iran and Iraq. The average annual growth rate of labor productivity of this group during this period was just -3.42 percent per annum. Though Finland was the only country with the positive average annual growth rate of labor productivity, its labor force was not considered to be so much productive due to a very small growth rate of 0.05 percent per annum.

The situation got much better during 1986 – 1990 when the average annual growth rate of labor productivity of the western developed countries rose sharply to 17.48 percent per

Table 1: Average Annual Growth Rates of Labor Productivity during 1981 – 2005

Country	1981-1985	1986-1990	1991-1995	1996-2000	2001-2005	1981-2005
G7 Countries						
Canada	3.94	8.44	-0.14	2.74	6.73	4.34
France	-4.65	18.10	4.71	-3.84	9.47	4.76
Germany	-5.24	19.12	7.58	-5.66	7.99	4.76
Italy	-1.53	20.71	1.25	-0.80	9.47	5.82
Japan	4.09	17.31	10.81	-2.10	0.27	6.08
United Kingdom	-3.75	16.35	3.35	4.22	8.67	5.77
United States	7.21	5.21	3.74	4.41	3.62	4.84
Mean	**0.01**	**15.03**	**4.47**	**-0.15**	**6.60**	**5.19**
Western Developed Countries						
Australia	-0.24	9.65	2.79	-0.16	12.21	4.85
Austria	-3.79	19.06	6.28	-4.10	9.32	5.35
Belgium	-7.59	19.95	6.04	-5.00	9.82	4.64
Denmark	-3.01	17.56	6.99	-2.73	10.50	5.86
Finland	0.05	20.28	1.32	-2.44	9.70	5.78
Greece	-4.10	14.93	5.65	-2.36	13.70	5.57
Iceland	-3.56	16.37	0.68	2.82	12.19	5.70
Ireland	-1.35	18.57	5.45	3.85	14.51	8.21
Netherlands	-6.86	16.67	5.86	-3.88	9.16	4.19
New Zealand	-1.72	14.10	5.63	-3.62	15.24	5.93
Norway	-1.42	12.48	5.17	1.08	11.26	5.71
Portugal	-4.44	23.75	8.79	-1.31	9.20	7.20
Spain	-5.38	22.96	2.35	-2.24	11.96	5.93
Sweden	-4.03	17.55	2.55	-0.75	8.40	4.74
Switzerland	-3.93	18.31	5.11	-5.34	9.10	4.65
Mean	**-3.42**	**17.48**	**4.71**	**-1.74**	**11.08**	**5.62**
Eastern Developed Countries						
Hong Kong	2.10	15.83	12.01	1.38	-0.47	6.17
South Korea	6.76	19.36	12.32	1.06	7.80	9.46
Singapore	5.78	12.43	15.46	-0.78	3.53	7.28
Mean	**4.88**	**15.87**	**13.26**	**0.55**	**3.62**	**7.64**
Eastern Developing Countries						
China	7.45	1.10	14.45	9.47	12.32	8.96
Indonesia	0.56	2.21	9.63	0.45	10.07	4.58
Malaysia	2.43	2.89	12.24	-1.60	5.15	4.22
Philippines	-3.39	4.85	7.89	-1.13	1.87	2.02
Thailand	0.85	14.40	13.80	-6.27	6.56	5.87
Mean	1.58	5.09	11.60	0.19	7.19	5.13

Source: Author's Calculation

annum before the Gulf war which happened in 1990 would deteriorate the world economy again, causing the average annual growth rate of labor productivity during 1991 – 1995 to steeply fell to 4.71 percent per annum. Moreover, the economic crisis which started in Thailand in 1997 had worsened the world economy, causing the average annual growth rate of labor productivity of the western developed countries to decrease further to -1.74 percent per annum during 1996 – 2000. During this period, only Iceland, Ireland and Norway could have the positive growth rates of labor productivity. The world economy got better during 2001 – 2005 when western developed countries had the very high average annual growth rate of labor productivity of 11.08 percent per annum.

The average annual growth rates of labor productivity of G7 countries during 1981 – 2005 were also high, ranging from 4.76 percent per annum in France and Germany to 6.08 percent per annum in Japan. During 1981 – 1985, every European G7 country had the negative average annual growth rates of labor productivity perhaps due to the second oil crisis whereas Canada, Japan and the USA could have the positive average annual growth rates of labor productivity during this period. Labor productivity of G7 countries grew much faster during 1986 – 1990 when the average annual growth rate of labor productivity of this group increased sharply to 15.03 percent per annum. Canada and the USA had the average annual growth rates of labor productivity of 8.44 and 5.21 percent per annum, respectively, whereas those of the other G7 countries exceeded 15 percent per annum.

The Gulf War, which started in 1990, deteriorated labor productivity growth of G7 countries, causing the average annual growth rate of labor productivity to decrease steeply to 4.47 percent per annum during 1991 – 1995. Japan was the only country with the average annual growth rate of labor productivity greater than 10 percent per annum whereas Canada was the only country with the negative average annual growth rate of labor productivity. Furthermore, the East Asian economic crisis which happened in 1997 caused the average annual growth rate of labor productivity of G7 countries during 1996 – 2000 to become negative at -0.15 percent per annum. During 2001 – 2005, the average annual growth rate of labor productivity of G7 countries increased to 6.60 percent per annum. Every G7 countries, except Japan and the USA whose average annual growth rates of labor productivity were only 0.27 and 3.62 percent per annum, had the average annual growth rates of labor productivity higher than six percent per annum.

When we turn to eastern developing countries, it seems that labor productivity growth of this group was not that high despite the high average annual growth rate of labor productivity of 5.13 percent per annum. Based on *Table 1*, the average annual growth rates of labor productivity of the Philippines was only 2.02 percent per annum whereas those of Indonesia and Malaysia were lower than 5 percent per annum and that of Thailand was 5.87 percent per annum. As a result, it is reasonable to conclude the average annual growth rate of labor productivity of this group was heavily influenced by that of China which equaled 8.96 percent per annum and, of course, overestimated.

During 1981 – 1985, the average annual growth rate of labor productivity of this group was 1.58 percent per annum. The best China could do during this period having the highest average growth rate of labor productivity of 7.45 percent per annum, following by Malaysia whose average annual growth rate of labor productivity was 2.43 percent per annum, whereas

the other countries had the average annual growth rates of labor productivity under 1 percent per annum. During 1986 – 1990, labor forces of the eastern developing countries were said to be more productive with the average annual growth rate of labor productivity of 5.09 percent per annum. Thailand had the highest average annual growth rate of labor productivity during this period of 14.40 percent per annum. This was the result from the higher trade openness, leading to the economic expansion.

The Gulf War did not affect the eastern developing countries' economies during 1991 – 1995 when the average annual growth rate of labor productivity of this group increased further to 11.60 percent per annum. This was the result from the higher trade openness and the industrial development in every eastern developing country. However, Thailand's economic crisis caused the economic recession in almost every eastern developing country, leading to the sharp drop in the average annual growth rate of labor productively to 0.19 percent per annum during 1996 – 2000. Thailand, the origin of the crisis, had the lowest average growth rate of labor productivity of -6.27 percent per annum. Nevertheless, China was not affected by the crisis as much as the others, still having the high average growth rate of labor productivity of 9.47 percent per annum. During 2001 – 2005, Asian countries' economies recovered from the crisis. The average annual growth rate of labor productivity of the eastern developing countries rose to 7.19 percent per annum during this period.

2. The Determinants of the Growth Rate of Labor Productivity

The results mentioned above describe the situation regarding labor productivity growth of G7 countries, western developed countries, eastern developed countries and eastern developing countries during 1981 – 2005. Now the study will focus on the factors determining the growth rate of labor productivity which include education, health and technological progress. In this study, education is measured by mean years of schooling, health is measured by life expectancy at birth and technological progress is measured by annual growth rate of total factor productivity. The mean values of these three factors of each country during 1981 – 2005 are shown in *Table 2*.

According to *Table 2*, western developed countries, in average, had the highest education with the mean value of mean years of schooling of 15.10 years during 1981 – 2005, following by G7 countries and eastern developed countries whose mean values of mean years of schooling equaled 14.92 and 13.38 years, respectively. In addition, eastern developing countries, in average, had the lowest education with the mean value of mean years of schooling of only 10.49 years. Australia had the highest mean years of schooling of 16.44 years whereas China had the lowest one of 9.84 years.

In term of health, eastern developing countries had the shortest average life expectancy at birth of 68.61 years whereas those of G7 countries, the western developed countries and the eastern developed countries were 77.22, 76.85 and 73.39 years, respectively. Japan had the longest life expectancy at birth in this study and also in the World. Its average life expectancy at birth during 1981 – 2005 was 79.52 years. Indonesia had the shortest average life expectancy at birth of 62.76 years during 1981 – 2005.

Additionally, the findings reveal that eastern developed countries had the highest

Table 2: Mean Values of the Variables during 1981 – 2005

Country	y	x_1	x_2	x_3
G7 Countries				
Canada	4.34	16.19	77.86	3.01
France	4.76	14.71	77.14	3.32
Germany	4.76	14.90	76.14	3.63
Italy	5.82	13.98	77.46	4.15
Japan	6.08	14.10	79.52	4.52
United Kingdom	5.77	15.45	76.22	3.93
United States	4.84	15.13	76.18	3.34
Grand Mean	**5.19**	**14.92**	**77.22**	**3.70**
Western Developed Countries				
Australia	4.85	16.44	77.70	3.20
Austria	5.35	14.79	76.10	3.78
Belgium	4.64	15.49	76.32	3.15
Denmark	5.86	15.31	75.62	3.72
Finland	5.78	16.16	75.92	4.10
Greece	5.57	13.74	76.90	3.84
Iceland	5.70	15.45	78.70	3.31
Ireland	8.21	13.88	75.38	5.46
Netherlands	4.19	15.57	77.32	2.92
New Zealand	5.93	16.12	76.24	3.59
Norway	5.71	15.25	77.46	4.24
Portugal	7.20	13.66	74.82	5.13
Spain	5.93	15.15	77.64	3.44
Sweden	4.74	15.37	78.22	3.33
Switzerland	4.65	14.14	78.34	3.45
Grand Mean	**5.62**	**15.10**	**76.85**	**3.78**
Eastern Developed Countries				
Hong Kong, China	6.17	14.00	78.28	4.48
Korea, Rep.	9.46	14.19	66.40	6.24
Singapore	7.28	11.94	75.50	5.59
Grand Mean	**7.64**	**13.38**	**73.39**	**5.44**
Eastern Developing Countries				
China	8.96	9.84	69.00	5.39
Indonesia	4.58	10.18	62.76	2.93
Malaysia	4.22	10.60	72.24	2.85
Philippines	2.02	11.29	70.62	1.85
Thailand	5.87	10.51	68.42	3.36
Grand Mean	**5.13**	**10.49**	**68.61**	**3.28**

Remark: y = annual growth rate of labor productivity, x_1 = mean years of schooling, x_2 = life expectancy at birth and x_3 = annual growth rate of total factor productivity

Source: Author's Calculation

technological progress with the average annual growth rate of total factor productivity of 5.44 percent per annum, following by western developed countries, G7 countries and eastern developing countries whose average annual growth rates of total factor productivity equaled 3.78, 3.70 and 3.28 percent per annum, respectively. South Korea could do the best in improving technology with the average annual growth rate of total factor productivity of 6.24 percent per annum whereas the Philippines had the lowest average annual growth rate of total factor productivity of 1.85 percent per annum.

Table 3 presents the statistical results from the regression analysis. The finding reveals that the estimated regression equation is statistically significant at 5 percent level with the F-statistic for overall significance test of 391.047. The adjusted R-Square is 0.940, implying that the explanatory variables in the equation could explain the total variation in the average annual growth rate of labor productivity by 94 percent. Based on *Table 3*, there is no Multi-collinearity problem arising in the regression analysis since the VIF of every explanatory variable, excluding dummy variables, is less than three. However, it seems that there is a negative Autocorrelation problem in the regression analysis since Durbin-Watson Statistic (D) from the regression analysis (see *Table 3*) equals 2.588 whereas the lower Durbin-Watson critical value (D_L) for 149 observations and 6 variables at 5% level is 1.649, making $4 - D_L$ equal 2.351. Fortunately, thanks to our large sample, Central Limit Theorem (CLT) still holds. That is, the OLS estimators are likely to be asymptotically consistent, consequently the estimated equation from the regression analysis is considered to be valid (Pindyck and Rubinfeld, 1998).

Table 3: Statistical Results from the Regression Analysis

Variable	Coefficient	Std. Error	Standardized Coefficient	t-Statistic	Variance Inflation Factor
Intercept	2.334	3.446	-	0.677	-
x_1	0.208*	0.105	0.064	1.972	2.645
x_2	-0.065	0.054	-0.038	-1.207	2.501
x_3	1.557*	0.032	0.975	48.196	1.019
r_1	-0.955	0.700	-0.054	-1.364	3.942
r_2	-0.710	0.663	-0.048	-1.071	4.944
r_3	-1.143	0.677	-0.046	-1.688	1.856
Dependent Variable	y (average annual growth rate of labor productivity)				
Durbin-Watson Statistic	2.588				
Number of Observations	149				
Std. Error of the Estimate	1.826				
Adjusted R-Square	0.940				
F-Statistic	391.047*				

Remark: * = Statistically Significant at 5% Level

Based on *Table 3*, only two factors which include mean years of schooling and the average annual growth rate of total factor productivity are statistically significant at 5 percent level, implying that labor productivity growth is determined by education and technological progress. The regression coefficient of mean years of schooling is 0.208, meaning that 1 year increase

in mean years of schooling will lead to 0.208 percent increase in the annual growth rate of labor productivity. Furthermore, the regression coefficient of the average annual growth rate of total factor productivity is 1.557, meaning that 1 percent increase in the annual growth rate of total factor productivity will lead to 1.557 percent increase in the annual growth rate of labor productivity.

In addition, after considering the standardized regression coefficients, it is reasonable to conclude that the most important determinant of the growth rate of labor productivity is the growth rate of total factor productivity which represents technological progress with the standardized coefficient of 0.975 whereas that of mean years of schooling which represents education is only 0.064. Additionally, the dummy variables for country groups (r_1, r_2 and r_3) are not statistically significant at 5 percent level, indicating that there is no significant difference of the average annual growth rates of labor productivity among G7 countries, western developed countries, eastern developed countries and eastern developing countries.

IV. CONCLUSION

This study shed more light on the situation regarding labor productivity growth of 30 countries categorized into four groups which included G7 countries, western developed countries, eastern developed countries and eastern developing countries during 1981 – 2005. The findings reveal that the average annual growth rates of labor productivity of every country, except Philippines whose average annual growth rate of labor productivity was only 2.02 percent per annum, were greater than four percent per annum during 1981 – 2005. Eastern developed countries had the highest average annual growth rate of labor productivity during 1981 – 2005 of 7.64 percent per annum, following by western developed countries, G7 countries and eastern developing countries whose average annual growth rates of labor productivity were 5.62, 5.19 and 5.13 percent per annum, respectively.

However, it seems that labor productivity growth of the eastern developing countries was overestimated since the average annual growth rate of labor productivity of this group was heavily influenced by that of China which equaled 8.96 percent per annum whereas the average annual growth rate of labor productivity of the eastern developing countries, excluding China, was only 4.17 percent per annum. Additionally, only education, as measured by mean years of schooling, and technological progress, as measured by the average annual growth rate of total factor productivity, are the significant determinants of the growth rate of labor productivity. Furthermore, technological progress is considered as the most important determinant of labor productivity growth.

Eventually, the governments as well as the authorities in every country must focus on the improvement of labor productivity if they wish to raise the standard of living of people in their countries. That is, the infinite improvement of labor productivity will ultimately lead to the sustained improvement of the standard of living. This study gives some statistical evidences regarding labor productivity growth and the determinants of labor productivity growth. Hopefully, this will be the useful information for the government sector for the development policy designation in the future. Moreover, education and technological progress in this study are measured only by a single measurement. Therefore, it may be necessary to find an

alternative measurement of these two factors and study all over again to confirm the result from this study. In addition, the influence of health on labor productivity growth should be re-investigated to confirm the result as well.

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